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GLOSSARY OF TERMS USED IN HIGH VACUUM TECHNOLOGY

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GLOSSARY OF TERMS USED IN HIGH VACUUM TECHNOLOGY

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Indian Standard
GLOSSARY OF TERMS USED IN HIGH VACUUM TECHNOLOGY

0. FOREWORD

0.1 This Indian Standard was adopted by the Indian Standards Institution on 24 April 1967, after the draft finalized by the Chemical Engineering Sectional Committee had been approved by the Mechanical Engineering Division Council.

0.2 This glossary has been prepared for the guidance of the workers, in the rapidly growing field of vacuum technology, to assist them in the correct interpretation of the common terms used in this field.

0.2.1 This glossary contains terms of general application without regard to the use or purpose of the vacuum system. A separate standard is being prepared which will include terms relating to particular vacuum applications.

0.3 There are many cases in this glossary where more than one term has been used in respect of a particular definition. Where an alternate term has been given, it appears in italics and the preferred term continues to to be in bold type.

0.4 This standard has been divided into six sections as given below:

Section 1 General terms
Section 2 Vacuum operations
Section 3 Pumps and associated terms
Section 4 Gauges and manometers
Section 5 Vacuum systems and their components
Section 6 Leak detection

0.4.1 Each term has been assigned to it a three digit number. The first digit represents the number of the Section and the last two digits renresent the serial number of the definition.

0.5 Symbols and abbreviations used in the standard are listed in Appendix A. Appendix B gives the relationship between the units of pressure recommended in this standard and certain other commonly used units of pressure. To facilitate easy reference an alphabetical index is included at the end.

0.6 This glossary is based on Doc : 66/23500 'Draft British Standard glossary of terms used in vacuum technology, *revision* of B.S. 2951 : 1958 Part 1 : Terms of general application' issued by the British Standards Institution.

1. SCOPE

1.1 This glossary covers definition of terms commonly used in the field of vacuum technology.

SECTION I — GENERAL TERMS

VACUUM AND RANGES OF VACUUM

101. **Vacuum** — The ranges of pressure below atmospheric pressure.

NOTE — The points of change in the ranges of vacuum in 102 to 105 are not the same in the two units of pressure, since it is more important that they be indicated by convenient round numbers.

102.	**Rough Vacuum**	760 to 1 torr	10^5 to 10^2 N/m²
103.	**Medium Vacuum**	1 to 10^{-3} torr	10^2 to 10^{-1} N/m²
104.	**High Vacuum**	10^{-3} to 10^{-8} torr	10^{-1} to 10^{-6} N/m²
105.	**Ultra-High Vacuum**	Below 10^{-8} torr	Below 10^{-6} N/m²

PRESSURE (SYMBOL : p)

106. **Pressure (on a Boundary Surface)**

Total Pressure

The normal component of the force exerted by a gas on an area of a real surface divided by that area (the orientation of the surface relative to the mass flow vector being specified if there is a net mass flow of gas).

107. **Pressure (at a Specified Position in a Gas)**

Total Pressure

The rate of transfer of the normal component of momentum, associated with the passage of molecules in both directions, through a small area of a plane located at the specified position, divided by that area (the orientation of the plane relative to the mass flow vector being specified if there is a net mass flow of gas).

NOTE 1 — The term 'pressure' when used alone refers to the pressure in a gas at rest or the static pressure in a gas flowing under steady-state conditions.

NOTE 2 — The term 'total pressure' is often used to denote the sum of all the partial pressures of the constituents of a gas mixture in contexts where the shorter term 'pressure' might not clearly distinguish between the individual partial pressures and their sum.

108. **Partial Pressure (of a Specified Molecular Species)** — The pressure due to the specified molecular species among those exerting force on the real surface (*see* 106) or crossing the plane (*see* 107).

109. **Static Pressure** — The pressure with respect to a stationary surface tangential to the mass-flow velocity vector; or the pressure with respect to a surface translated with a velocity equal to and parallel to the mass-flow velocity.

110. **Dynamic Pressure** — The pressure with respect to an imaginary stationary surface whose positive normal is parallel to the mass-flow velocity vector.

Kinetic Pressure

111. **Velocity Pressure** — The difference between dynamic pressure and static pressure.

Velocity Head

UNITS OF PRESSURE (*see also* APPENDIX B)

112. **Newton per Square Metre** — The unit of pressure of the International System (SI)* derived from the SI unit of force, the newton, that is that force which when applied to a body having a mass of one kilogramme, gives it an acceleration of 1 m/s^2.

Unit symbol : N/m^2.

113. **Torr** — The unit of pressure defined by the following exact relationships:

$$760 \text{ torr} = 1 \text{ standard atmosphere (atm)} = 101\ 325\ N/m^2 = 1\ 013\ 250\ dyn/cm^2$$

**See* : IS 3616-1966 Recommendations on the International System (SI) units.

MOLECULAR DENSITY

114. **Molecular Density (at a Specified Position in a Gas)** — The instantaneous value of the number of molecules present in a small volume at the specified position, divided by that volume.

115. **Partial Molecular Density (of a Specified Molecular Species, at a Specified Position in a Gas)** — The instantaneous value of the number of molecules of the specified species present in a small volume at the specified position divided by that volume.

GASEOUS STATE

116. **Gas** — Matter in which the molecules are virtually unrestricted by intermolecular forces so that they are free to occupy any space within an enclosure.

NOTE — Unless the context requires otherwise, in this glossary the word ' gas ' includes non-condensable gas and vapours.

117. **Perfect Gas**
Ideal Gas — A gas which obeys Boyle's law and Charles' law.

118. **Non-condensable Gas** — A gas which cannot be liquefied by increase of pressure alone, that is, one whose temperature is above its critical temperature.

119. **Vapour** — A gas which can be condensed to the liquid state or to the solid state by increase of pressure alone, that is, one whose temperature is below its critical temperature.

120. **Saturated Vapour** — A vapour which is in equilibrium with it solid or liquid phase.

121. **Saturation Vapour Pressure** — The pressure exerted by a vapour wh in equilibrium with its solid or liq phase.

122. **Unsaturated Vapour** — A vapour which exerts a pressure than its saturation vapour pressure.

123. **Supersaturated Vapour** A vapour which exerts a pressure greater than its saturation vapour pressure.

124. **Degree of Saturation** The ratio of the pressure exerted by a vapour to its saturation vapour pressure.

TRANSPORT PHENOMENA IN GASES

125. **Mean Free Path (of a Particle)** The average distance which a particle in a gas travels between successive collisions with other particles.

126. **Diffusion** A phenomenon in the course of which adjacent layers of a substance tend towards uniformity of concentration.

127. **Diffusion Coefficient** *Diffusivity* The coefficient relating diffusion flow to the concentration gradient of the diffusing substance in accordance with the relationship:

Symbol : D

$$J = -D \frac{\delta c}{\delta x}$$

where

J is the quantity of the diffusing substance passing per unit time through a small area of a plane perpendicular to the direction of flow divided by that area (unit: quantity of substance per square metre),

D is the diffusion coefficient (unit: m^2/s),

c is the concentration of the diffusing substance (unit: quantity of substance per cubic metre), and

x is measured in the direction of flow (unit: m).

NOTE 1 — No units are specified for the quantity of substance in this definition since a number of units may be used provided J and c are expressed in the same unit. Grams, moles, numbers of molecules and pressure-volume units are typical of those which may be used.

NOTE 2 — Alternatively, the relationship defining D may be expressed independently of any co-ordinate system:

$$J = -D \text{ grad } c$$

here J and grad c are the vectors defining the flow and concentration gradient of the diffusing substance.

128. **Molecular Effusion** — The passage of gas through an opening in a thin lamina under conditions such that the largest dimension of the opening is smaller than the mean free path.

129. **Molecular Flow** — The passage of a gas through a tube under conditions such that the largest internal dimension of a transverse section of the tube is smaller than the mean free path.

130. **Viscous Flow** — The passage of a gas through a pipe or system under conditions such that the mean free path is very small in comparison with the smallest internal dimension of a transverse section of the pipe or system, the flow being therefore dependent on the viscosity of the gas. (The flow may be laminar or turbulent.)

131. **Poiseuille Flow** — The particular case of laminar viscous flow through a long pipe of circular section.

132. **Knudsen Flow** — The flow of gas through a pipe or system under conditions intermediate between laminar viscous flow and molecular flow.

133. **Thermal Transpiration** — The passage of gas, under molecular flow conditions, through a connection between two vessels due to a difference in the temperatures of the vessels which results in a pressure gradient when gas transfer equilibrium is reached.

FLOW OF GASES

134. **Quantity of Gas (in Pressure-Volume Units)** — The pressure of a gas at a specified temperature in a given volume multiplied by that volume.

Symbol : pv

Unit : torr litre* or newton metre (Nm)

*The litre for the purposes of this standard is exactly equal to one cubic decimetre.

135. **Molecular Flux or Flow of Molecules** — The algebraic sum of the numbers of gas molecules crossing a specified surface in an interval of time divided by that time. (Those having a velocity component in the same direction as the normal to the surface at the point of crossing are counted as positive and those having a velocity component in the opposite direction are counted as negative.)

136. **Throughput** — The quantity of gas (in pressure-volume units) at a specified temperature flowing in unit time across a specified open cross-section.

Symbol : Q

Unit : torr litre per second or newton metre per second (N m/s)

NOTE — The throughput is sometimes only concerned with one of the constituents of a gas and in that case the relevant pressure is the partial pressure of that constituent.

137. **Mass Throughput** — The mass of gas flowing in a unit time across a specified open cross-section.

Unit : gram per second (g/s)

138. **Volumetric Throughput** — The volume of gas, at specified temperature and pressure, flowing in unit time across a specified open cross-section.

Unit : litre per second (l/s)

139. **Conductance** — Measured between two specified cross-sections, is the ratio of the throughput Q of gas under steady-state conditions to the difference in measured pressures, P_1 and P_2, at the two specified cross-sections.

Symbol : U

Unit : litre per second (l/s)

$$U = \frac{Q}{P_1 - P_2}$$

140. **Intrinsic Conductance (of a Duct)** — The conductance measured when the duct is placed between two vessels, large compared with the entrance and exit of the duct, one of which is connected to a supply of gas and the other to a pump so as to establish a pressure difference between the two vessels. The intrinsic conductance is the throughput (under steady-state conservative conditions) divided by the difference in pressure between the vessels.

141. **Resistance** — The reciprocal of the conductance.

Impedance

Symbol : W

Unit : second per litre (s/l)

$$W = \frac{1}{U}$$

INTER-ACTION OF GASES WITH LIQUIDS AND SOLIDS

142. **De-gassing** — The deliberate removal of gas from a material.

143. **Out-Gassing** — The spontaneous evolution of gas from a material.

144. **Sorption** — The taking up of gas by a solid or a liquid.

145. **Sorbent** — Material which takes up gas by sorption.

146. **Sorbate** — Gas taken up by the sorbent in sorption.

147. **De-sorption** — The process of removing sorbed gas

148. **Adsorption** — Sorption in which the gas (the adsorbate) is retained at the surface of the solid or liquid (the adsorbent).

NOTE — Adsorption may be taking place at the same time.

149. **Physical Adsorption** *Physisorption* — Adsorption in which no definite chemical binding occurs.

150. **Chemical Adsorption** *Chemisorption* — Adsorption involving formation of surface compounds by chemical reaction.

151. **Absorption** — Sorption in which the gas (the absorbate) diffuses into the bulk of the solid or liquid (the absorbent).

NOTE — Absorption may be taking place at the same time.

152. **Persorption** — Sorption due to pores throughout the bulk of a substance which, arising from its crystalline structure, are of a substantially uniform size slightly greater than that of the molecules of the sorbate.

153. **Occlusion** — The retention of gas in the interior voids of a solid.

154. **Condensation Coefficient** — The ratio of the rate at which molecules condense on a surface to the rate at which they arrive at that surface.

NOTE — This term is distinct from and should not be confused with the term 'condensation coefficient of heat transfer' which is sometimes used in heat transfer calculations to denote the coefficient of heat transfer of condensation.

155. **Accommodation Coefficient** Symbol α — The ratio of the mean energy actually transferred between impinging gas molecules and a surface to the mean energy which would have to be transferred for the impinging molecules, to return from the surface having reached complete thermal equilibrium with the surface.

Thus, $E_i - E_r = \alpha (E_i - E_s)$

where

E_i = mean energy of incident molecular stream,

E_r = mean energy of reflected or re-emitted molecular stream, and

E_s = mean energy of molecular stream in thermal equilibrium with the surface.

In conditions in which the mean energy of the gas molecules may be indicated by their temperature,

$$T_i - T_r = \alpha (T_i - T_s)$$

where

T_i = temperature of incident molecular stream,

T_r = temperature of reflected or re-emitted molecular stream, and

T_s = temperature of surface.

156. **Sticking Probability** — The ratio of the rate at which particles are sorbed at a surface to the rate at which they arrive at that surface.

NOTE — In this definition 'are sorbed' does not mean that the molecules must be permanently sorbed. It is sufficient for them to enter a sorbed state and become thermally accommodated to the surface. In appropriate cases the type of sorption should be specified.

157. **Residence Time** — The average time for which a molecule is bound to a surface in a state of sorption.

NOTE — In appropriate cases, the type of sorption should be specified.

158. **Permeation** — The passage of gas through a solid barrier.

NOTE — The process involves diffusion of the gas through the solid and may involve various surface phenomena.

159. **Permeability Coefficient**
Permeation Coefficient — The quantity of gas passing in an interval of time through unit area of a permeable wall divided by the mean pressure gradient within the wall and by that time.

SECTION 2 VACUUM OPERATIONS

201. **Static Conditions** — The conditions prevailing when the pressure is uniform throughout a vacuum chamber and there is consequently no positive gas flow.

202. **Dynamic Conditions**	The conditions prevailing when the pressure is not uniform throughout a vacuum chamber and there is consequently positive gas flow.
203. **Ultimate Pressure**	The limiting pressure approached in a vacuum chamber after pumping for sufficient time to establish that further reduction in pressure will be negligible.
204. **Blanked-Off Pressure**	The limiting pressure approached in a blanked-off inlet to a pump after pumping for sufficient time to establish that further reduction in pressure will be negligible.
205. **Backing Pressure**	The pressure at the outlet of a pump which discharges gas to a pressure below atmospheric.
206. **Critical Backing Pressure (cbp)**	The value of the backing pressure, at a stated throughput, at which a slight rise in the backing pressure causes on the high vacuum side of the pump a rise in the ultimate pressure abruptly greater than that caused by the same increase at lower backing pressures. NOTE — In some pumps the increase does not occur abruptly and the critical backing pressure is then not precisely determinable.
207. **Backing Space**	The space in a vacuum system between the outlet of a pump and the inlet of its backing pump.
208. **Throttling**	A reduction of the conductance of a component.
209. **Guard Vacuum**	An enclosure, in which the pressure is less than atmospheric, between a vacuum vessel or part of a vacuum system and the atmosphere, which serves to reduce the rate of leakage into the inner member or to reduce the mechanical forces acting on the inner member, or both.
210. **Bake-Out**	The degassing of parts of a vacuum system by heating during evacuation.

211. **Torching** — The degassing of parts of a vacuum system by the application of local heat to the walls during evacuation.

212. **Bombardment Heating** — The raising of the temperature of parts in a vacuum system by the impact of particles.

213. **Virtual Leak** — The semblance of a leak due to evolution of gas or vapour within a vacuum system.

214. **Time Constant** — Of a vacuum chamber. The ratio of the volume of the vacuum chamber to the pumping speed.

NOTE — The time constant, like the pumping speed, varies for different gases or vapours.

215. **Roughing Time** — The time taken for the roughing pump to evacuate a vacuum system from atmospheric pressure to the pressure at which the second pump begins to operate.

216. **Pump-Down Time** — The time required to reduce the pressure in a vacuum chamber from atmospheric to the operating pressure.

NOTE — 'Pump down time' should not be confused with 'pump down time' which is the period when a pump is not ready for use.

217. **Venting Time** — The time required to raise the pressure in a vacuum system, or in a given part of it, from the operating value to atmospheric pressure by admitting a gas through a specified conductance.

218. **Seal-Off** — The final act of sealing off a vacuum device after evacuation and processing.

219. **Rate Of Rise** — At a given time, the time rate of pressure increase in a vacuum chamber at constant temperature, which has been suddenly isolated from the pump.

220. **Clean-Up** — The process of removing gas from a vacuum chamber or vessel by sorption.

SECTION 3 PUMPS AND ASSOCIATED TERMS

301. **Vacuum Pump** — A device for reducing the pressure of gas in a vessel or system, or for maintaining such a reduction of pressure.

302. **Roughing Pump** — A vacuum pump for reducing the pressure in a vessel or system from atmospheric to a lower value at which a second pumping system can begin to operate.

303. **Backing Pump** — A vacuum pump for maintaining the backing pressure of another pump below its critical value.

304. **Holding Pump** — An auxiliary backing pump for maintaining the backing pressure of certain types of vacuum pump when the throughput does not warrant the use of the main backing pump.

305. **Booster Pump** — A vacuum pump used between a vapour pump and a backing pump to increase the throughput of a pumping system.

NOTE 1 — A booster pump serves either to increase the throughput of a vapour pump and backing pump of a given size, or to enable a given throughput to be handled by a smaller vapour pump and backing pump.

NOTE 2 — Booster pumps are normally either mechanical booster pumps (*see* 314 Note) or vapour booster pumps (*see* 327 Note).

306. **Mechanical Vacuum Pump** — A vacuum pump in which gas is transported by the rotary or reciprocating movement of mechanical parts.

307. **Oil-Sealed Mechanical Vacuum Pump** — A mechanical vacuum pump in which oil is used to seal the gap between parts which move with respect to one another, and to reduce the residual free volume in the pump chamber at the end of the compression part of the cycle.

308. **Positive Displacement Pump** — A mechanical vacuum pump in which the gas is drawn in, compressed and discharged by means of periodic variations in the volume of the working chamber.

309. **Piston Pump** — A positive displacement pump in which the periodic variation of the volume of the working chamber is brought about by the movement of a reciprocating piston in a cylinder.

310. **Positive Displacement Rotary Pump** — A positive displacement pump in which the gas is transported by motion which is mainly rotary.

311. **Rotary Piston Pump** — A positive displacement pump in which a crescent-shaped working chamber is swept by a combination of a rotor running eccentrically and a single sliding blade.

312. **Sliding Vane Rotary Pump** — A positive displacement pump with an eccentrically placed rotor and one or more sliding vanes operating in an approximately radial direction and dividing the static crescent-shaped working chamber into circulating vacuum-tight regions of periodically increasing and decreasing volume.

313. **Liquid Ring Pump** — A positive displacement pump in which the crescent-shaped working chamber is formed between a rotating liquid ring and an eccentrically placed rotor with fixed blades.

314. **Roots Pump** — A positive displacement pump in which a pair of inter-locking and synchronised lobed rotors rotate in opposite directions, moving past each other and the housing wall with a small clearance and without touching.

NOTE — A Roots pump used as a booster pump (*see* 305) is often termed a 'mechanical booster pump'.

315. **Kinetic Pump** — A mechanical vacuum pump in which the gas is moved in a steady stream from the inlet to the outlet by the conversion of kinetic energy into pressure energy.

316. **Radial Flow Pump** — A kinetic pump in which the direction of flow of the gas is predominantly parallel to the axis of rotation.

317. **Axial Flow Pump** — A kinetic pump in which the direction of flow of the gas is predominantly at right angles to the axis of rotation

318. **Molecular Drag Pump** A kinetic pump in which momentum is imparted to the molecules of the gas by contact between them and the surface of a high speed rotor.

319. **Turbo-Molecular Pump** A molecular drag pump in which the rotor has inclined slots or blades moving between corresponding slots or blades in a stator.

320. **Gas Ballast Pump** An oil-sealed mechanical pump in which a controlled quantity of a suitable non-condensable gas is admitted during the compression part of the cycle so as to transport condensable vapours with reduced contamination of the sealing oil.

321. **Fluid Entrainment Pump** A vacuum pump in which a high speed jet of liquid or gas impels the gas being transported in the direction of the outlet.

322. **Liquid Jet Pump** A fluid entrainment pump in which a fast moving liquid is used as the driving medium.

323. **Gas Jet Pump** A fluid entrainment pump in which a high speed fit of gas is used as the driving medium.

324. **Vapour Pump** A fluid entrainment pump in which the transport of the gas is effected by a jet or jets of vapour.

325. **Ejector Pump** A vapour pump in which the gas moves to and enters the vapour stream under conditions in which viscous flow predominates.

326. **Diffusion Pump** A vapour pump in which the gas moves to and enters the vapour stream under conditions in which molecular flow predominates.

327. **Diffusion-Ejector Pump** A multi-stage vapour pump in which a stage or stages having the characteristics of a diffusion pump are succeeded by a

stage or stages having the characteristics of an ejector pump.

NOTE — Certain types of diffusion-ejector pump normally used as booster pumps (*see* 305) are often termed 'vapour booster pumps'.

328. **Intermediate Range Vapour Pump** A vapour pump in which the gas moves to and enters the vapour stream under conditions in which neither viscous flow nor molecular flow predominates.

329. **Fractionating Pump** A multi-stage vapour pump in which the operating fluid is fractionated and supplied to the nozzles of successive stages in order of vapour pressures, the constituent of lowest vapour pressure being supplied to the lowest pressure stage.

330. **Self-Purifying Pump** A vapour pump in which the volatile impurities in the operating fluid are, as far as possible, transported towards the outlet and prevented from returning to the boiler.

331. **Toepler Pump** A vacuum pump in which the raising of a column of liquid (normally mercury) closes the intake port and compresses the gas in a chamber, which is then discharged through a discharge valve.

332. **Sprengel Pump** A vacuum pump in which gas is transported between successive short columns of a liquid (normally mercury) falling in a vertical tube.

333. **Sorption Pump** A vacuum pump containing a surface, usually renewable, which retains gas and thus reduces the pressure by sorption.

334. **Getter Pump** A sorption pump in which the trapping surface is a metal or metal alloy, either in bulk or in the form of a film deposited by vaporization or sputtering.

335. **Cryopump** A vacuum pump which operates by the condensation or sorption or both of gas at surfaces maintained at a temperature sufficiently low for the vapour pressures of the condensed gases to be insignificant.

336. **Ion Pump** — An electrical device consisting of a means of ionising gases and a system of electrodes at suitable potentials and in some cases also a magnetic field, which causes the ions to be transported towards an auxiliary pump or trap

337. **Ion-Sorption Pump** — An ion pump in which the gas molecules are transported to a sorption surface.

338. **Getter-Ion Pump** — An ion-sorption pump in which the gas molecules and ions are trapped in a metallic sorbent which is renewed by getter action either intermittently or continuously.

339. **Cold Cathode Getter-Ion Pump**

Sputter-Ion Pump

A getter-ion pump in which a getter film is produced by the sputtering action at a cathode maintained in a gaseous discharge, usually confined within a magnetic field.

340. **Evaporation Getter-Ion Pump** — A getter-ion pump in which a getter film is produced by the evaporation on heating of a suitable metal.

341. **Trap** — A device in which one or more of the constituents of the gas in a vacuum system are removed from the gas, thus effecting a reduction in the partial pressure or pressures of that constituent or those constituents.

342. **Cold Trap** — A trap which operates by reduction of temperature.

343. **Inlet** — The intake port of a pump; the port by which gas enters a component.

344. **Outlet** — The output or discharge port of a pump; the port by which gas leaves a component.

345. **Expansion Chamber** — The increasing space within a mechanical vacuum pump into which gas flows from the high vacuum part of a vacuum system.

346. **Compression Chamber** — The decreasing space within a mechanical vacuum pump in which the gas is compressed before being discharged through the outlet.

347. **Vane** — A sliding member which divides into compartments the working space between the rotor and stator of a rotary mechanical pump.

Blade

348. **Discharge Valve** — A valve operated automatically during the discharge of gas from the compression chamber of a mechanical vacuum pump.

349. **Feather Valve** — A discharge valve formed of a thin strip of metal, sometimes held in place by springs.

350. **Poppet Valve** — A discharge valve consisting of a metal disc retained in a suitable housing by a spring.

351. **Pump Oil** — Liquid used for sealing or lubrication in a mechanical vacuum pump.

352. **Oil Separator** — A device which reduces the loss of pump oil as droplets at the outlet.

353. **Oil Purifier** — A device for removing contaminants from the pump oil.

354. **Pump Fluid** — The operating fluid in a vapour pump.

355. **Boiler** — The part of a vapour pump in which the pump fluid is converted by heating into vapour to feed the nozzle or nozzles.

356. **Heater Input** — The electrical power supplied to the heater of the boiler of a vapour pump.

Unit : Watt (W)

357. **Boiler Pressure** — The pressure at the surface of the pump fluid in the boiler of a vapour pump.

358. **Vapour Tube** — The tube through which the vapour passes from the boiler to the nozzle or nozzles of a vapour pump.

Vapour Pipe
Vapour Chimney

359. **Nozzle** — The part of a vapour pump used to direct the flow of the pump fluid in order to produce the pumping action.

360. **Jet** — The stream of pump fluid issuing from a nozzle in a vapour pump.

361. **Nozzle Throat** — The part of the nozzle having the smallest cross-sectional area.

362. **Nozzle Expansion Ratio** — The ratio of the area of the exit aperture of a nozzle to the nozzle throat area.

363. **Nozzle Clearance Area** — The smallest cross sectional area between the outer rim of a nozzle and the wall of the pump casing.
Unit: Square metre (m^2)

364. **Nozzle Clearance** — The width of the annulus determining the nozzle clearance area.

365. **Diffuser** — The converging or diverging section of the wall of an ejector pump.

366. **Diffuser Throat** — The part of a diffuser having the smallest cross-sectional area.

367. **Jet Assembly** — The integral system of nozzles and vapour ducts that can be removed from a vapour pump.

368. **Skirt** — The lower part of the jet assembly, usually enlarged, separating the returning condensed pump fluid and the generated vapour at the pump boiler.

369. **Condenser (of a Vapour Pump)** — A system of cooled surfaces placed in front of and to the sides of a vapour jet to condense the vapour and return the pump fluid to the boiler.

370. **Baffle** — An obstruction placed near the inlet of a vapour pump to impede the passage of back-streaming and/or back-migrating vapour into the high vacuum part of the system.

371. **Back-Streaming** — The passage of molecules of the pump fluid of a vapour pump to the high vacuum side of the pump (and of any associated baffle or trap) following their diverging from the jet of vapour and their scattering on impact with surfaces of gas molecules.

372. **Back-Migration** — In relation to a vapour pump. The passage of molecules of the pump fluid to the high vacuum side of the pump (and of any associated baffle or trap) following their re-evaporation from surfaces in the pump or on the backing pressure side of it.

In relation to a mechanical vacuum pump. The passage of vaporised molecules of the sealing fluid or of the lubricant to the high vacuum side of the pump (and of any associated baffle or trap).

373. **Back-Diffusion** — The passage of molecules of the gas being pumped by a vacuum pump, by diffusion through the gas or vapour in it, from the backing pressure side to the high vacuum side of it (and of any associated baffle or trap).

374. **Warm-Up Time** — The time required to bring the boiler of a vapour pump from the ambient temperature (or from a specified temperature lower than the highest temperature at which the boiler may be safely opened to the atmosphere) to the normal operating temperature.

375. **Cool-Down Time** — The time required for the boiler temperature of a vapour pump to fall, after isolation from the heat supply, from the normal operating temperature to a specified temperature at which the boiler may be safely opened to the atmosphere.

376. **Pumping Speed** — For a given pump and a given gas entering it from a given test dome under specified operating conditions, the throughput of the gas divided by the steady-state pressure at a specified point in relation to the pump inlet.

Symbol : S

Unit : litre per second (l/s)

Thus, $S = Q/p$

NOTE — An ideal definition of pumping speed would be ' The volumetric rate of flow across a section at the pump inlet '. The quantity defined above is the one nearest to this ideal which can be measured in practical terms.

377. **Test Dome**
Test Header
A chamber attached to the inlet of a pump and equipped with means of pressure measurement through which a measured flow of gas may be admitted to the pump.

SECTION 4 MANOMETERS AND GAUGES

401. **Vacuum Gauge** — An instrument for measuring gas pressures less than normal atmospheric pressure.

402. **Absolute Vacuum Gauge** — A vacuum gauge by which such physical measurements are taken that the pressure being measured is calculated using constants and these measurements without reference to another vacuum gauge.

403. **Differential Vacuum Gauge** — A vacuum gauge for measuring the difference between total or partial pressures existing simultaneously at two places.

404. **Partial Pressure Vacuum Gauge** — A vacuum gauge for measuring the partial pressures of constituents of gaseous mixtures.

405. **Gauge Sensitivity** — The deflection of the indicator or the change in indicating current per unit difference of pressure being measured.

406. **Gauge Head** — Of certain types of gauge. The part of the gauge containing the pressure-sensitive elements which are directly exposed to the vacuum being measured.

407. **Nude Gauge** — A gauge having a gauge head without envelope, the sensitive gauge element being inserted directly into the vacuum system.

408. **Fast Gauge**
Fast Response Gauge — A gauge having a relatively short gauge head with wide bore tubulation.

409. **Gauge Control Unit** — Of certain types of gauge. The part of the gauge containing the power supplies which receives the signal from the gauge head and, after amplification or other processing, passes it to the gauge indicating unit or recorder.

410. **Gauge Indicating Unit** Of certain types of gauge. The part of the gauge containing the output device, usually calibrated in units of pressure.

411. **Liquid Level Manometer** A differential vacuum gauge, commonly a U-tube, in which pressure differences are measured in terms of differences in liquid levels.

NOTE — If the pressure above one surface of the liquid is maintained at a known value or at a value negligible compared with the pressure being measured, the gauge is an absolute vacuum gauge.

412. **Dubrovin Gauge** *Cartesian Diver Gauge* A gauge the essential part of which is a thin-walled tube sealed at its upper end and floating vertically in a liquid. (The equilibrium position is determined by the forces due to gravity, the gas pressure to be measured, and the weight of liquid displaced by the immersed part of the tube.)

413. **Diaphragm Gauge** A differential gauge in which the deflection of a flexible diaphragm separating gases at different pressures is used to measure the pressure difference.

414. **McLeod Gauge** A liquid level vacuum gauge in which a known volume of the gas at the pressure to be measured is compressed by the movement of a liquid column to a much smaller known volume, at which the resulting higher pressure is measured.

NOTE — For gases which obey Boyle's law, this gauge is an absolute vacuum gauge.

415. **Viscosity Gauge** A vacuum gauge dependent on the interaction of the gas with the movement of an element of the gauge, for use in the ranges of pressure in which viscosity is dependent upon pressure.

416. **Decrement Gauge** A viscosity gauge dependent on the rate of decay of the amplitude of the periodic vibration of an element suspended in the gas.

417. **Molecular Drag Gauge** — A viscosity gauge in which a surface is given a high velocity relative to another closely situated surface, so that molecules leaving the moving surface exert on the second surface a force whose magnitude is a function of the gas pressure.

418. **Piezoelectric Gauge** — A vacuum gauge in which the vibrations of a piezoelectric crystal are communicated to the surrounding gas.

419. **Knudsen Gauge** — A vacuum gauge which measures pressure in terms of the net rate of transfer of momentum by molecules between two surfaces maintained at different temperatures and separated by a distance much smaller than the mean free path of the gas molecules.

420. **Thermal Conductivity Gauge** — A vacuum gauge dependent on the change, with changes of pressure, of the rate of loss of heat from a heated element in the gas.

421. **Pirani Gauge** — A thermal conductivity gauge in which the temperature of the element is measured in terms of its electrical resistance. (The element forms part of a Wheatstone bridge circuit; measurement is made either of the imbalance resulting from pressure changes or of the bridge voltage required to maintain the filament temperature constant and hence keep the bridge balanced.)

422. **Thermistor Gauge** — A Pirani gauge in which the heated element is a thermistor.

423. **Thermocouple Gauge** — A thermal conductivity gauge in which the temperature of the heated element is measured by a thermocouple.

424. **Ionization Gauge** — A vacuum gauge in which pressure is measured in terms of the ion current produced in the gas under controlled conditions.

425. **Hot Cathode Ionization Gauge**
Thermionic Cathode Ionization Gauge — An ionization gauge in which ionization is produced by electrons emitted from a thermionic cathode.

426. **Cold Cathode Ionization Gauge** — An ionization gauge in which ionization is produced by electrons emitted from an unheated cathode. (There is generally a self-maintained glow discharge between two electrodes either in a magnetic field or without such a field.)

427. **Discharge Tube** — A transparent tube in which the colour and form of an electrical discharge give an indication of the pressure and nature of the gas.

428. **X-Ray Limit** — The pressure below which an ionization gauge is not effective due to residual ionization current at the ion collector caused by X-radiation induced at the electron-collecting electrode.

429. **Ultra-High Vacuum Ionization Gauge** — An ionization gauge in which the electrode structure is designed to minimize the X-ray-induced electron omission from the ion collector.

430. **Bayard-Alpert Gauge** — A triode hot cathode ionization gauge in which the X-ray limit is depressed by the use of a thin ion collector wire arranged centrally in a cylindrical grid with the cathode mounted outside the grid.

431. **Suppressor Ionization Gauge** — A hot cathode ionization gauge in which the X-ray limit is depressed by mounting a suppressor electrode in the vicinity of the ion collector so that any secondary electrons emitted at the collector are returned to it.

432. **Hot Cathode Magnetron Gauge** — A hot cathode ionization gauge in which a magnetic field is used to lengthen the electron path and so increase the number of ions produced. (The instrument resembles a simple cylindrical magnetron operating under cut-off conditions).

433. **Modulator Ionization Gauge** — A hot cathode ionization gauge fitted with a modulator electrode in which the effect of residual currents (including any X-ray currents) may be estimated by measuring the effect on the ion collector current of varying the potential applied to the modulator.

434. **Ionization Gauge Constant**

Symbol: C

For a given gas, the ratio of ionization current to the product of the ionizing electron current and the corresponding pressure. (The operating parameters should be stated.)

$$\text{Thus, } C = \frac{I_1}{I_2\, p}$$

where

I_1 = ionization current

I_2 = ionizing electron current, and

p = pressure.

Unit: with I_1 and I_2 in self-consistent units and p in torr, C will be in torr^{-1}.

435. **Penning Gauge** — A cold cathode ionization gauge in which a magnetic field is used to lengthen the electron path and so increase the number of ions produced.

436. **Cold Cathode Magnetron Gauge** — A Penning gauge having electrodes arranged as coaxial cylinders, with the cathode the inner one, and an axial magnetic field.

437. **Inverted Magnetron Gauge** — A Penning gauge having electrodes arranged as coaxial cylinders, with the anode the inner one, and an axial magnetic field.

438. **Radioactive Ionization Gauge** — An ionization gauge in which ionization is produced by radiations emitted from a radio-active source. (Where the radiations are α-particles, the instrument is often known as the 'alphatron gauge'.)

439. **Mass Spectrometer** — An instrument which separates ionized particles of different mass/charge ratios and measures the respective ion currents.

NOTE — The mass spectrometer may be used as a vacuum gauge to measure the partial pressure of a specific gas, as a leak detector sensitive to a particular search gas, or as an analytical instrument to determine the percentage composition of a gas mixture. Types are distinguished by the methods of separating the ions.

440. **Magnetic Deflection Mass Spectrometer** — A mass spectrometer in which ions are accelerated through a slit and then deflected by a magnetic field so as to pass through a second slit.

NOTE — In the 180°-deflection mass spectrometer and in the 90°- and 60°-deflection sector field mass spectrometers the ions are deflected through 180°, 90° and 60° respectively.

441. **Double Focusing Mass Spectrometer** — A mass spectrometer in which ions are separated by the successive actions of a radial electrostatic field and a magnetic sector field so that the velocity dispersion is opposite and approximately equal in the two analysers.

442. **Trochoidal Focusing Mass Spectrometer**

Cycloidal Focusing Mass Spectrometer

A mass spectrometer in which ions are separated by crossed electric and magnetic fields in which they follow different cycloidal paths, coming to different foci depending on their mass or charge ratios.

443. **Time of Flight Mass Spectrometer** — A mass spectrometer in which gas is ionized by a pulse-modulated electron beam and each group of ions is accelerated towards an ion collector at the far end of a drift space, the difference in the times of arrival of ions in a group depending upon their mass or charge ratios.

444. **Radio Frequency Mass Spectrometer**

Linear Resonance Mass Spectrometer

A mass spectrometer in which ions travel in a linear path and are accelerated through a series of openings or grids alternately attached to a radio frequency oscillator, emerging into an electrostatic field which permits only the ions accelerated in the radio frequency field to reach the collector.

445. **Omegatron Mass Spectrometer** A mass spectrometer in which ions are separated by following spiral paths of increasing radius due to a cyclotron resonance effect provided by high frequency electric and steady magnetic fields which are perpendicular to one another.

446. **Quadrupole Mass Filter** A mass spectrometer in which ions are injected axially into a quadrupole lens consisting of a system of four rods to which high frequency and dc electric fields in a critical ratio are applied.

447. **Monopole Mass Spectrometer** A mass spectrometer in which an L-shaped electrode and a single rod symmetrically disposed to it provide a field configuration similar to that in one quadrant of the quadrupole, ions being injected near to the corner of the L-shaped electrode and only ions with a certain mass or charge ratio (depending on the electric fields) emerging.

SECTION 5 VACUUM SYSTEMS AND THEIR COMPONENTS (OTHER THAN PUMPS AND GAUGES)

501. **Vacuum System** A vacuum chamber and the components for producing, measuring and controlling the vacuum.

502. **Vacuum Chamber** An enclosure within which the required low gas pressure is produced.

503. **Ultra-High Vacuum System** A vacuum system in the vacuum chamber of which a pressure below 10^{-8} torr may be produced.

NOTE — Similarly rough, medium and high vacuum systems (*see* 102 to 104).

504. **Demountable Vacuum System** A vaccum system in which one or more joints may be readily disconnected and reconnected.

505. **Sealed Vacuum System** A vacuum system in which all the joints are permanent or semi-permanent.

506. **Vacuum (Adjustment)** Suitable for use in connection with a vacuum system, normally having a low vapour pressure.

NOTE — The term may be applied to waxes, greases, cements and paints, lubricants and other fluids, etc.

507. **Gasket** A closed loop of deformable material pressed between the two parts of a joint to make it gas tight.

508. **Gasket Seal** A seal effected by the deformation of a gasket between the parts being joined.

509. **O-Ring Gasket** A toroidal gasket made to specified dimensions and tolerances.

510. **V-Ring Gasket** A gasket made of material having a uniform trapezoidal cross-section.

511. **L-Ring Gasket** A gasket made of material having a uniform L-shaped cross-section.

512. **Flat Gasket** A gasket made from sheet material.

SEALS

513. **Hermetic Seal** A seal designed to permit no detectable leak.

514. **Housekeeper Seal** A hermetic seal made by the fusion of a glass tube to the feather edge of a coaxial tube of copper or other suitable metal.

515. **Disc Seal** A hermetic seal made by the fusion of the ends of two coaxial glass tubes of equal diameter to the opposite faces of a disc of copper or other suitable metal.

516. **Matched Glass-To-Metal Seal** A hermetic seal made by the fusion of glass to metal or alloy having a coefficient of thermal expansion close to that of the glass.

517. **Graded Seal** A seal made of a series of materials graded in order of their coefficients of thermal expansion; adjacent materials having nearly similar coefficients, used to avoid undesirably large stresses in the joining of parts of a vacuum system having dissimilar coefficients of expansion.

518. **Compression Type Glass-To-Metal Seal** — A hermetic seal made by the fusion of glass to a metal or an alloy so that the glass is at all times subject to compression.

519. **Ceramic-To-Metal Seal** — A hermetic seal in which the metalized surface of a ceramic and a metal or alloy are joined by the fusion of an interposed metal or alloy of lower melting point.

520. **Hermetic Shaft Seal** — A seal in which the flexure of bellows or a diaphragm hermetically sealed to a wall and a shaft permits some movement of the shaft relative to the wall.

521. **Packed Shaft Seal** — A seal in which packing material or one or more gaskets surround a shaft capable of rotary or linear movement relative to the wall.

522. **Rotary Vacuum Seal** — A seal designed to prevent leakage where a rotating shaft enters a vacuum system.

523. **Wilson Seal** — A rotary vacuum seal in which line contact is made between a shaft and a circular flat gasket in which the hole is slightly smaller than the shaft so that the gasket assumes a conical form.

524. **Vacuum Manifold** — An enclosure to which two or more vacuum devices may be connected with the object of simultaneous evacuation.

525. **Pumping Stem** — A tube extending from a vacuum device through which gas is removed and which is usually hermetically sealed when the device has been evacuated.

526. **Vacuum Valve** — A device for adjusting the rate of flow of a gas or for completely stopping the flow.

527. **Isolating Valve** — A vacuum valve characterized by an on or off action with little or no intermediate quantitative control of the gas flow but which when closed reduces the gas throughput between the parts of a vacuum system, to zero or to an insignificant amount, which it separates.

528. **Regulating Valve** — A vacuum valve giving close quantitative control of the gas throughput between the parts of a vacuum system which it separates.

529. **Body (of a Valve)** — The main part of the valve in which the flow of fluid is controlled.

530. **Port** — An opening at the inlet or outlet of any component of a vacuum system, through which gas flows.

(Of a Valve) — The variable opening within the valve body at which the flow is controlled as it moves from the inlet to the outlet.

531. **Seat (of a Valve)** — The formed area against which the seal is made when the valve is closed.

532. **Valve Stem** — The part of a valve which transmits motion from the actuating component to the part adjusting the flow or effecting closure.

533. **Bonnet (of a Valve)** — The part of a valve, rigidly attached to the body, through which the stem passes.

534. **Bonnet Gasket** — A gasket placed between the bonnet and the body of a valve.

535. **Seat Gasket** — A gasket which seals the port when the valve is closed.

536. **Back Seat Gasket** — A gasket arranged to seat, to prevent leakage through the bonnet and stem assembly when the valve is open.

537. **Packed Vacuum Valve** — A vacuum valve in which the stem passes through packing material which forms the seal between the stem and the bonnet.

538. **Packless Vacuum Valve** — A vacuum valve in which there is no motion of the stem through a packed seal.

539. **Bellows Sealed Valve** — A packless vacuum valve in which the seal between the stem and the body is effected by a flexible bellows.

540. **Diaphragm Valve**	A packless vacuum valve in which the seal between the stem and the body is effected by a flexible diaphragm.
541. **Plate Valve**	A vacuum valve in which when the valve is closed the port is closed by a plate pressed against the seat.
542. **Disc Valve**	A plate valve in which the plate is circular.
543. **Quarter-Swing Vacuum Valve**	A plate valve in which the plate lies in the flow, parallel to the flow when the valve is open and across the flow when the valve is closed.
544. **Butterfly Valve**	A quarter-swing vacuum valve in which the axis of rotation of the plate lies at or near the centre of the plate.
545. **Flap Valve**	A quarter-swing vacuum valve in which the axis of rotation of the plate lies near the edge of the plate.
546. **Baffle Valve**	A plate valve in which when the valve is open the plate serves as a baffle.
547. **Gate Valve**	A valve in which the plate moves in a plane perpendicular to the common axis of the inlet, the port and the outlet so as to leave a clear passage when the valve is open.
548. **Needle Valve**	A valve in which a tapered needle moving with respect to the seat provides an annular port of varying size enabling the flow to be closely controlled.
549. **Ball Valve**	A valve in which a ball rotates in the body so that a bore through the ball may be aligned with the inlet and outlet.
550. **Plug Valve**	A valve in which a conical plug is rotated so that one or more bores through the plug may be aligned with the inlet and the outlet.
551. **Glass Stopcock**	A plug valve made of glass.

552. **Cut-Off**	A device in which a liquid surface is used when required to separate two parts of a vacuum system. NOTE — The use of this term to describe components which are really traps or valves is deprecated.
553. **Electro-magnetic Vacuum Valve**	A vacuum valve actuated by the passage of an electric current through a solenoid associated with the valve.
554. **Pneumatic Vacuum Valve**	A vacuum valve actuated by the passage of air or either gas into or out of a pneumatic cylinder associated with the valve.
555. **Hydraulic Vacuum Valve**	A vacuum valve actuated by the passage of a hydraulic fluid into or out of a hydraulic cylinder associated with the valve.
556. **Backing Line**	The pipe system connecting a pump to its backing pump.
557. **Backing Valve**	A vacuum valve placed in the backing line to permit the isolation of a pump from its backing pump.
558. **Backing Reservoir**	A vessel placed between a pump and its backing valve to serve as a gas receiver whilst the associated backing pump is not in use.
559. **Roughing Line**	A pipe system connecting vacuum equipment to a roughing pump.
560. **Roughing Valve**	A vacuum valve placed in the roughing line to permit the isolation of vacuum equipment from its roughing pump.
561. **Gas Admittance Valve**	A vacuum valve used to permit the entry of gas into a vacuum system.
562. **Air Admittance Valve**	A vacuum valve used to permit the entry of air directly from the atmosphere into a vacuum system.
563. **Liquid Catch Pot**	A vessel in a vacuum system designed to collect liquid and to prevent its accidental entry into other parts of the vacuum system. Liquid catchpots guarding against the entry of particular liquids may be termed, for instance, oil catchpot, water catchpot. NOTE — The use of the term 'trap' for these devices is deprecated in order to avoid confusion with the use of 'trap' at 341.

SECTION 6 LEAK DETECTION

601. **Leak (in Vacuum Technology)** — A hole or porosity in a boundary allowing gas to pass from one side of it to the other under the action of a pressure or concentration difference.

602. **Leakage** — The gas passing or having passed through the leak.

Unit : torr litre,
newton metre (Nm) or
joule (J = Nm)

603. **Leak Rate** — The quantity of gas passing through the leak in a given time divided by that time.

Symbol : L or Q_L

Unit : torr litre per second
newton metre per second (Nm/s) or
watt (W = J/s)

NOTE — Except when one side of the boundary is at atmospheric pressure and the other at a pressure negligible by comparison, a leak rate value only has significance if the pressures on either side of the boundary are stated.

604. **Viscous Flow Leak** *Viscous Leak* — A leak of such a size that the flow through it is predominantly viscous flow and that the leak rate is mainly controlled by the viscous flow of the gas.

605. **Molecular Flow Leak** *Molecular Leak* — A leak of such a size that the flow through it is predominantly molecular flow.

606. **Leak Detection System** — A complete apparatus by which the presence of leaks can be detected and an indication of their magnitudes obtained.

607. **Leak Detector** — An instrument or device for detecting the presence of leaks and obtaining some indication of the magnitude of the leak rate.

608. **Vacuum Test** — A test in which the equipment under test is subjected to a pressure lower than that surrounding it.

609. **Pressure Test** — A test in which the equipment under test is subjected to a pressure in excess of that surrounding it.

610. **Pressure Rise Test** — A method of determining whether there is a leak or a virtual leak in a system, or of obtaining an estimate of its magnitude, by observing the rate of rise of pressure in the evacuated system when it is isolated from the pump.

611. **Search Gas** — A gas introduced into the equipment under test and detected as it is emitted from the leak in a pressure test or applied to the outer surface of the equipment under test and detected after it has entered the equipment through the leak in a vacuum test.

612. **Sample Probe**
Sniffer — A device used in pressure testing to collect search gas from a region of the equipment under test and pass it to the leak detector.

613. **Probe Test** — A method of leak location in which a jet of search gas or liquid is moved over the surface of the vacuum system and its entry through a leak detected.

614. **Hood Test** — A test in which the existence of a leak is verified by the entry into the system of a search gas contained in a hood or envelope surrounding the whole or a part of the system.

615. **Bubble Leak Test** — A pressure test in which search gas is detected by the appearance of bubbles in a liquid in which the equipment is immersed or in a layer of a suitable solution applied externally to it.

616. **Leak Proving** — Testing to determine whether the leak rate in a vacuum system or component does or does not exceed a specified value.

617. **Backing Space Leak Detection** — Leak detection in which the leak dectector is connected to the backing space of a vacuum pump and not to the high vacuum part of a system.

618. **Response Time** — The time taken after covering a leak with the search gas for the indication of the leak detector to rise to a value $(1 - \frac{1}{e})$ times, that is 63 per cent of, the value asymptotically attained when the search gas is indefinitely applied.

619. **Clearing Time** — The time taken after the removal of the search gas from the leak for the indication of the leak detector to fall to a value (1/e) times, that is 37 percent of the value at the time of removal.

620. **Vacuum Gauge Leak Detector** — A leak detector consisting of a partial pressure vacuum gauge responsive only to the search gas used.

621. **Differential Leak Detector** — A leak detector for vacuum testing incorporating two vacuum gauges, both of which respond to fluctuations of the total pressure but only one to the search gas, so that the effect of fluctuations of total pressure is reduced.

622. **Thermal Conductivity Leak Detector** — A leak detector used for pressure testing in which the search gas is detected by measuring the change in the thermal conductivity of the gas in the system on the entry of the search gas.

623. **Halide Leak Detector** — A leak detector for vacuum or pressure testing employing a halide as the search gas and depending on the increase of positive ion emission from a heated anode when halogen molecules impinge on it.

NOTE — This instrument should be distinguished from the 'halide torch detector' used primarily in refrigerator testing, which consists of a bunsen burner flame impinging on a copper plate and which shows the presence of halogen in the air intake of the burner by a change in the colour of the flame.

624. **Palladium Barrier Leak Detector** — A leak detector for vacuum testing employing hydrogen as a search gas and incorporating an evacuated gauge divided from the vacuum system by a palladium barrier which, when heated, is permeable to hydrogen.

625. **Ionization Gauge Diode Detector** — A leak detector for vacuum testing depending on the variation of temperature-limited thermionic electron emission in a diode under the influence of a suitable search gas.

626. **Mass Spectrometer Leak Detector** — A mass spectrometer adjusted to respond only to the search gas.

627. **HF Discharge Leak Detector** — An HF-generator having a probe which can be applied to the wall of a glass vacuum system to locate leaks.

628. **Tesla Coil Leak Detector** — An HF-discharge leak detector in which the HF-generator is a Tesla coil.

629. **Discharge Tube Leak Indicator** — A glass tube with electrodes attached to a high voltage source so that changes in the colour of the electrical discharge can be observed when a suitable tracer gas flows through the leak.

630. **Infra-Red Leak Detector** — A leak detector in which the presence of the search gas, normally nitrous oxide, is detected by its absorption in the infra-red region of the spectrum.

631. **Ultra-Violet Leak Detector** — A leak detector in which the presence of the search gas is detected by its absorption in the ultra-violet region of the spectrum.

632. **Noise Level (of a Leak Detector)** — The spurious indication given by the leak detector, expressed in equivalent leak rate or partial pressure units, which is not due to the action of gases on the detecting unit.

633. **Other-Gas Background (in Connection with a Leak Detector)** — The spurious indication given by the leak detector expressed in equivalent leak rate or partial pressure units, which is due to the action on the detecting unit of gases other than the search gas.

634. **Search-Gas Background (in Connection with a Leak Detector)** — The spurious indication given by the leak detector, expressed in equivalent leak rate or partial pressure units, which is due to the action on the detecting unit of the traces of the search gas present in the vacuum system prior to the application of the search gas to the leak.

635. **Background (in Connection with a Leak Detector)** — The total spurious indication given by the leak detector, expressed in equivalent leak rate or partial pressure units, that is that part of the indication which does not arise from the application of the search gas to the leak.

NOTE — Background is thus the summation of noise level, other-gas background and search gas background.

636. **Drift** — The time rate of variation of the background; expressed in equivalent leak rate or partial pressure units per unit time, over periods of time long in comparison with the time taken to make an individual reading.

637. **Sensitivity of a Leak Detection System** — The change in indication of the leak detector occurring in a specified time when a leak is completely covered by the search gas divided by the leak rate.

NOTE — The use of the term 'sensitivity' to mean 'minimum detectable leak' is deprecated. The definition of sensitivity given here is that used in connection with instruments in a wide range of fields.

638. **Pressure-Sensitivity of a Leak Detector** — The change in indication of the leak detector due to a change in the partial pressure of the search gas at its input divided by that change in partial pressure.

639. **Minimum Detectable Leak (of a Leak Detection System or a Leak Detector)** — The minimum leak rate that can be unambiguously detected.

NOTE — The relevant factors in assessing the minimum detectable leak include the background, the drift, the pressure-sensitivity of the leak detector and the sensitivity of the leak detection system.

640. **Rated Minimum Detectable Pressure Change** — The change in pressure which, within a specified time, causes a change in the indication given by the leak detector equal to a specified multiple of the mean of ten consecutive peak-to-peak fluctuations of the background or equal to 2 per cent of the full scale indication, whichever is the greater.

641. **Rated Minimum Detectable Change of Partial Pressure of Search Gas** — The change in partial pressure due to the search gas in the leak detection system which, within a specified time, causes a change in the indication given by the leak detector equal to a specified multiple of the mean of 10 consecutive peak-to-peak fluctuations of the background or equal to 2 percent of the full scale indication, whichever is the greater.

NOTE — The multiple on which either of these two rated minimum detectable values is based should be indicated.

642. **Minimum Detectable Concentration Ratio** — The minimum ratio of the partial pressure of search gas to total pressure in a mixture of search gas and air which can be unambiguously detected.

643. **Calibrated Leak** — A device providing a known leak rate of a given gas between the two parts of a vacuum system which it separates when there are specified pressures on its two sides.

644. **Reference Leak** — A calibrated leak used to check the performance of a leak detecting system.

645. **Membrane Leak** — A device which enables gas to be admitted to a vacuum system by permeation through a non porous wall.

APPENDIX A

(*Clause* 0.5)

SYMBOLS AND ABBREVIATIONS

A-1. The following recommendations relate to the symbols for the quantities and the abbreviations for the units used in this standard:

Quantity	*Symbol*
Accommodation coefficient	α
Conductance	U
Critical backing pressure	*cbp*
Diffusion coefficient	D

Quantity	*Symbol*
Ionisation gauge constant	C
Leak rate	L, Q_L
Pressure	p
Pumping speed	S
Quantity of gas (in pressure-volume units)	pv
Resistance, impedance	W
Throughput	Q
Volume	v

Unit	*Abbreviation*
Atmosphere, standard	atm
Centimetre	cm
Dyne	dyn
Dyne per square centimetre	dyn/cm^2
Gramme per second	g/s
Joule	J
Litre	l
Litre per second	l/s
Metre	m
Square metre	m^2
Square metre per second	m^2/s
Newton	N
Newton metre	Nm
Newton per square metre	N/m^2
Newton metre per second	N m/s
Second	s
Second per litre	s/l
Torr	torr
Torr litre	torr l
Torr litre per second	torr l/s
Watt	W

(For other units, *see* Appendix B)

APPENDIX B

(*Clause* 0.5)

UNITS OF PRESSURE

B-1. The units of pressure recommended for general use in vacuum technology are the newton per square metre and the torr, as defined in Section 1 of this glossary.

B-2. The bar, millibar and microbar (especially the millibar) have been in frequent use, related to the newton per square metre in the SI units and the dyne per square centimetre in the c.g.s. system by the following relationships:

a) 1 microbar (μb) $= 10^{-1}$ N/m^2 $= 1$ dyn/cm^2,
b) 1 millibar (mb) $= 10^2$ N/m^2 $= 10^3$ dyn/cm^2, and
c) 1 bar $= 10^5$ N/m^2 $= 10^6$ dyn/cm^2.

B-3. The standard atmosphere [termed normal atmosphere in IS : 1890 (Part III)-1961*] is defined as 101 325 newton per square metre.

B-4. All the pressure units indicated above have received international recognition. They are defined absolutely in newtons per square metre or dynes per square centimetre without reference to a column of liquid.

B-5. The conventional barometric millimetre of mercury (mmHg) is defined by reference to the millimetre of mercury. Thus while

$$1 \text{ mmHg} = 0{\cdot}1 \times 13{\cdot}595\,1 \times 980{\cdot}665 \text{ dyn/cm}^2 \text{ (exactly)}$$
$$= 1\,333{\cdot}22 \text{ dyn/cm}^2 \text{ (approximately)}$$
$$\text{and } 760 \text{ torr} = 1\,013\,250 \text{ dyn/cm}^2 \text{ (exactly)}$$
$$\text{so that } 1 \text{ torr} = 1\,333{\cdot}22 \text{ dyn/cm}^2 \text{ (approximately)}$$

The relationship 1 mmHg = 1·000 000 142 4 ... torr cannot be expressed exactly. However, the millimetre of mercury is equal to the torr within 1 part in 7×10^6 and 760 mmHg exceeds 1 atm by less than 2×10^{-7} atm. Some preference for the torr over the millimetre of mercury in vacuum technology is indicated by the reference in IS : 1890 (Part III)-1961* to the millimetre of mercury being used in meteorological barometry. The torr rather than the millimetre of mercury is recommended for use in vacuum technology in Section 1 of this glossary.

B-6. The term micron, meaning micrometre of mercury, may still be encountered in vacuum work but the equivalent pressure unit, that is millitorr, is preferred.

B-7. A conversion table of these pressure units appears on P 44. For conversion of other units reference should be made to IS : 786-1956†.

*Recommendations on quantities and units of mechanics.

†Conversion factors and conversion tables. (Since revised).

TABLE 1 CONVERSION TABLE OF CERTAIN PRESSURE UNITS

(For conversion of other units *see* IS : 786-1956 'Conversion factors and conversion tables')

	Dyne per Square Centimetre	Newton per Square Metre	Torr	Standard Atmosphere	Millibar	Millimetre of Mercury	Micrometre (Micron) of Mercury
One dyne per square centimetre (dyn/cm^2) =	$\underline{1}$	$\underline{10^{-1}}$	$7{\cdot}500\ 62 \times 10^{-4}$	$9{\cdot}869\ 23 \times 10^{-7}$	$\underline{10^{-3}}$	$7{\cdot}500\ 62 \times 10^{-4}$	$7{\cdot}500\ 62 \times 10^{-1}$
One newton per square metre (N/m^2) =	$\underline{10}$	$\underline{1}$	$7{\cdot}500\ 62 \times 10^{-3}$	$9{\cdot}869\ 23 \times 10^{-6}$	10^{-2}	$7{\cdot}500\ 62 \times 10^{-3}$	7·500 62
One torr (torr) =	1 333·22	133·322	$\underline{1}$	$1{\cdot}315\ 79 \times 10^{-3}$	1·333 22 ($1\frac{1}{3}$)	(1)	(10^3)
One standard atmosphere (atm) =	$\underline{1\ 013\ 250}$	$\underline{101\ 325}$	$\underline{760}$	$\underline{1}$	$\underline{1\ 013{\cdot}25}$	760·000	760 000
One millibar (mb) =	$\underline{10^3}$	$\underline{10^2}$	0·750 062 ($\frac{3}{4}$)	$9{\cdot}869\ 23 \times 10^{-4}$	$\underline{1}$	0·750 062 ($\frac{3}{4}$)	750·062
One millimetre of mercury (mmHg) =	1 333·22	133·322	(1)	$1{\cdot}315\ 79 \times 10^{-3}$	1·333 22 ($1\frac{1}{3}$)	$\underline{1}$	$\underline{10^3}$
One micrometre (micron) of mercury (µmHg) =	1·333 22	$1{\cdot}333\ 22 \times 10^{-1}$	(10^{-3})	$1{\cdot}315\ 79 \times 10^{-6}$	$1{\cdot}333\ 22 \times 10^{-3}$	$\underline{10^{-3}}$	$\underline{1}$

NOTE — Exact values are underlined to distinguish them from rounded values. Close approximations are shown in brackets. The errors in the approximations 1 mmHg (or 1 torr) = $1\frac{1}{3}$ mb and 1 mb = $\frac{3}{4}$ mmHg (or $\frac{3}{4}$ torr) may be seen from the table. The approximation 1 mmHg = 1 torr is closer than the rounded values in the table; to the number of significant figures used in the table the two are indistinguishable (*see* B-5).

ALPHABETICAL INDEX

NOTE 1 — Number references are to the terms and notes in the glossary.

NOTE 2 — Terms, such as Pressure, Partial Pressure, Static Pressure, are each entered alphabetically. Pressure (Partial), Pressure (Static) are not entered under the heading Pressure because they follow that term in the glossary. Pressure (Ultimate) is nevertheless entered because it does not follow 'Pressure' in the glossary. Other entries follow this pattern.

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